CONFIDENTIAL

Research Order #1
Phase I - Progress Report #6

3 June 1954

5 COPIES DISTRIBUTED AS FOLLOWS:

3 copies to:

1 copy to:

1 copy to:

25X1

25X1

CONFIDENTIAL

CONFIDENTIAL

Research Order #1 3 June 1954
Phase I - Progress Report #6

OBJECTIVE:

To study and evaluate the factors and components involved in the design of a portable infrared communicator.

GENERAL DATA:

The work to be performed according to Bid Proposal #76-1, Phase I, may be summarized as follows:

A. Evaluation of sources and sensitive elements

B. Determination of beam width requirements and evaluation of "find-operate" systems

C. Study of modulation methods and attendant optical systems

D. Evaluation of power sources

E. Study of required circuit characteristics

The results of these studies will be used as the basis for recommending a system to be developed.

DETAILED DATA:

A. Evaluation of sources and sensitive elements

Most of the work on this phase of the project was given to a further study of sensitive elements.

The following detectors were given consideration:

CONFIDENTIAL

Research Order #1 3 June 1954
Phase I - Progress Report #6

1. Silicon Cell
2. Thalofide Cell
3. Lead Selenide Cell
4. Lead Sulfide Cell

Previously the photomultiplier was discarded as a possibility. Among the reasons for discarding it were its size and power supply requirements (high voltage power supply).

The Silicon Cell

This cell has good frequency response, stability and is insensitive to background light - at least much more so than is the thalofide cell. However, the signal-to-noise ratio is not high, and its peak is in the near infrared (0.85 microns), thereby limiting visual security to a great degree.

Present state of the manufacturing art is not known, and it is questionable if commercial sources of a satisfactory nature are presently available.

The Thalofide Cell

Past experience indicates a rather wide variation in response characteristics, which indicates a problem of manufacturing technique; however, these techniques may have been considerably improved recently.

The thalofide cell has a few serious drawbacks. One drawback in our application is the fact that it is seriously affected by background light. This makes it quite unsatisfactory for daylight operation. Also, its spectral response cuts off at 1.3 microns, the peak occurring at 0.9 microns; thus it gives a poor match for tungsten or other blackbody sources. In commercially available types, the size of the sensitive area is very large.

Research Order #1 3 June 1954
Phase I - Progress Report #6

The Lead Selenide Cell

Information available indicates that it has been very difficult, if not impossible, to prepare lead selenide cells of uniform and equal sensitivities. Moreover, this cell is not readily available from reliable manufacturers.

The Lead Sulfide Cell

The lead sulfide cell has a peak response at approximately 2.5 microns and a cutoff near 3.5 microns. This cell is linear over a great range of luminous flux, which means that it is not affected seriously by background.

The cell has a high sensitivity, although not as high as the thalofide cells, and its sensitivity increases as ambient temperature decreases.

Much is known about the manufacturing techniques and methods of evaluating these cells. Commercial cells are available from several manufacturers, and a great deal of technical information in their use in numerous applications can be found in the literature, both military and civilian.

It is our opinion that the results of the study favor the lead sulfide cell for this application. We therefore plan to use this detector in future work. We have in our hands at the present time a number of lead sulfide cells which we can use in experimental work.

B. Determination of beam width requirements and evaluation of "find-operate" systems

Extensive work was not carried out on this phase of the project during the month of May due to the fact that more intensive efforts were put forth on the modulating and optical

systems than had originally been planned. However, the following problem has been set up for investigation which is being carried out at this time. Twenty minutes in our judgement is a maximum allowable time for searching. Arbitrary positional accuracies, both horizontal and vertical have been chosen as follows:

Horizontal	$\pm 5^{o}$
Vertical	$\pm 2^{o}$

With these requirements we wish to know how "narrow angle optics" can be used and the range with a suitable source of energy.

Previously a vertical angle of $\pm 5^{o}$ was considered. However, 5^{o} subtends a considerable vertical distance at ranges of from 4 to 6 miles; further it is our observation, that at 1^{o} and distances over 3 miles, the contact is on the horizon. Reducing the vertical angle will decrease find time and also increase security.

We have requested topographical maps of this locality and expect to make actual field observations to help us reach the proper decisions on the beam width requirements.

C. Study of modulation methods and attendant optical systems

Further calculations were made on the mechanical modulating systems, both translatory and torsional. The work resulted in fairly complete functional specifications for a mechanical modulator.

It appears that at least two possibilities exist for using mechanical systems with appropriate optics.

One method would use a mechanical shutter and a system of small lenses, the lenses being used to break up the light into narrow bands. Preliminary calculations indicate a power requirement less than one watt.

Research Order #1
Phase I - Progress Report #6

3 June 1954

Another very simple system (torsional system) would have the mirror reflect the light thru a rather large angle. Preliminary calculations indicate approximately 8 watts of power required to operate the galvanometer in this system.

A member of our group will meet with galvanometer manufacturers within the next ten days. At that time we shall know whether or not the modulator, as proposed, can be satisfactorily fabricated with the proper degree of ruggedness, sensitivity, etc., and still meet minimum weight requirements.

In the previous monthly report it was stated that we would again consider the xenon arc lamp as a source and consider problems involved in modulating such a source. We have received a number of 25 watt xenon lamps from Hanovia Chemical and Manufacturing Company. Work is now in progress to determine the feasibility of modulating the xenon lamp by electronic means. Actually since it is already known that a xenon lamp can be electronically modulated, the problem is to accomplish this modulation without getting a bulky or heavy unit.

D. Evaluation of power sources

The small alternators which were ordered for the engine generator set are due July 1, 1954. A new flywheel has been built for the small engine, and auxiliary equipment is being built to enable us to make sound level tests. It is not feasible to design a muffler system until proper sound level measurements are made. However, that is the next step in the evaluation of this particular power source.

E. Study of required circuit characteristics

We have practically completed the design and breadboard construction of an electronic circuit (the infinite clipping circuit). It is expected that sufficient experimental work will